Jitter corner in 100GBASE-ZR

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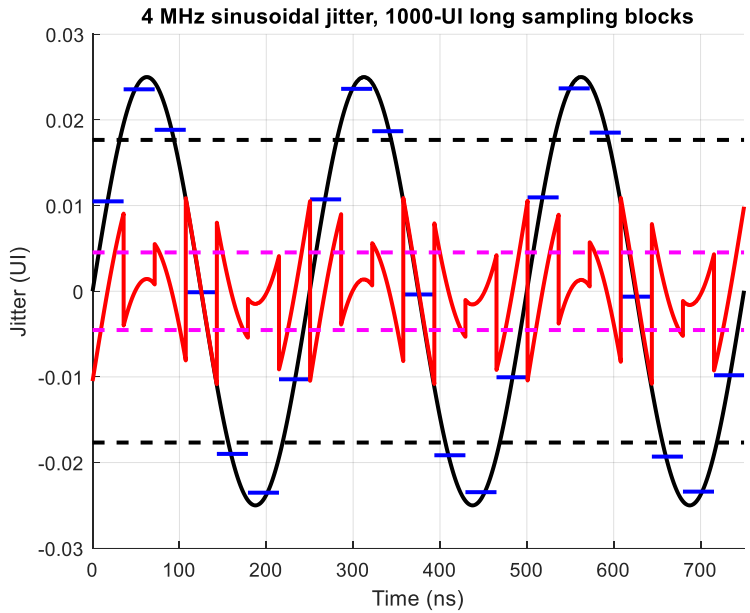
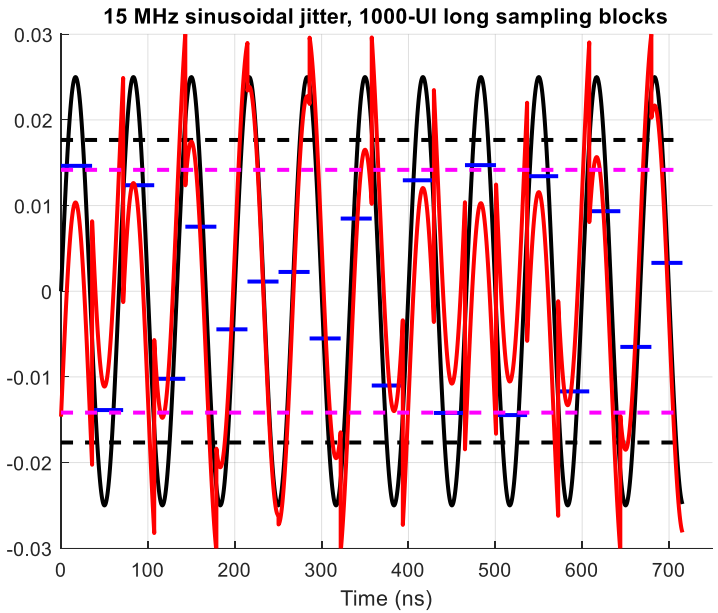
Problem statement

- Draft spec 100GBASE-ZR does not have the usual clock recovery unit in measurement or sinusoidal jitter component in stressed receiver sensitivity definition
  - D3.0 comment 85 and D3.1 comments 69 and 79, comments to D3.2
- So, what does it have?

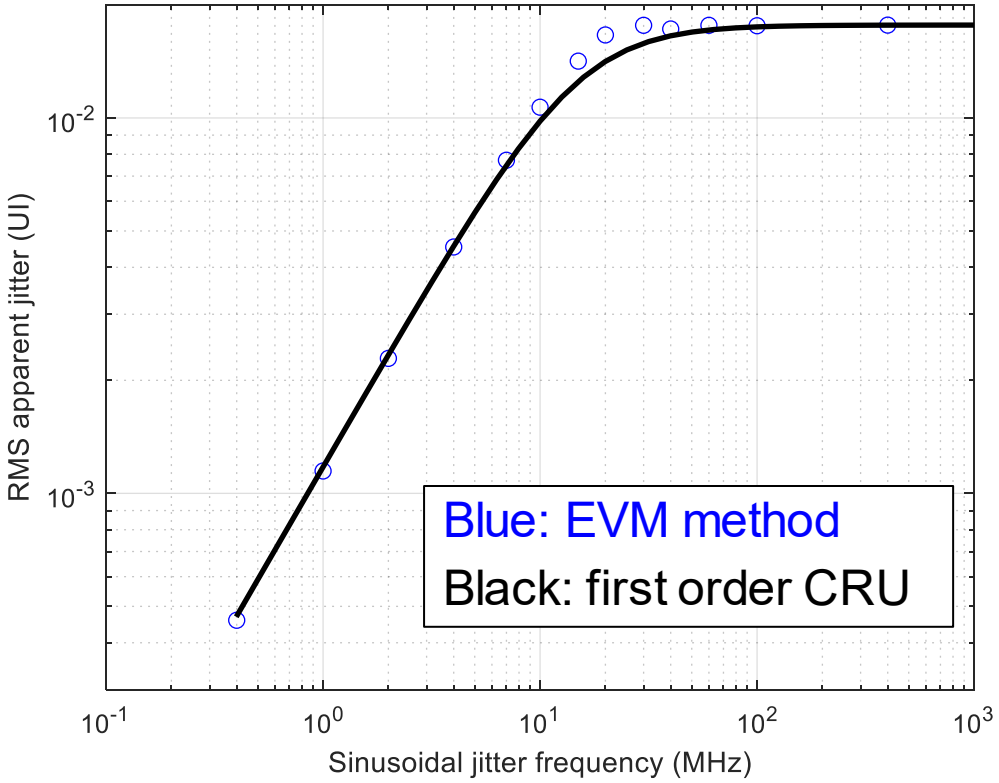
For EVM, a signal is measured in 1000-UI blocks





- In each block, the average phase of the data (blue bars) is removed, so the apparent jitter is the red line
- Dashed lines show +/- 1 standard deviation

Apparent SJ after EVM sampling



- Effective jitter corner of the default EVM method is 15.1 MHz
  - based on the LF roll-off, which is first order (20 dB/decade). The -3 dB point is 12.8 GHz
- Either way, it's far too high for a DSP receiver, and transmitters can do better

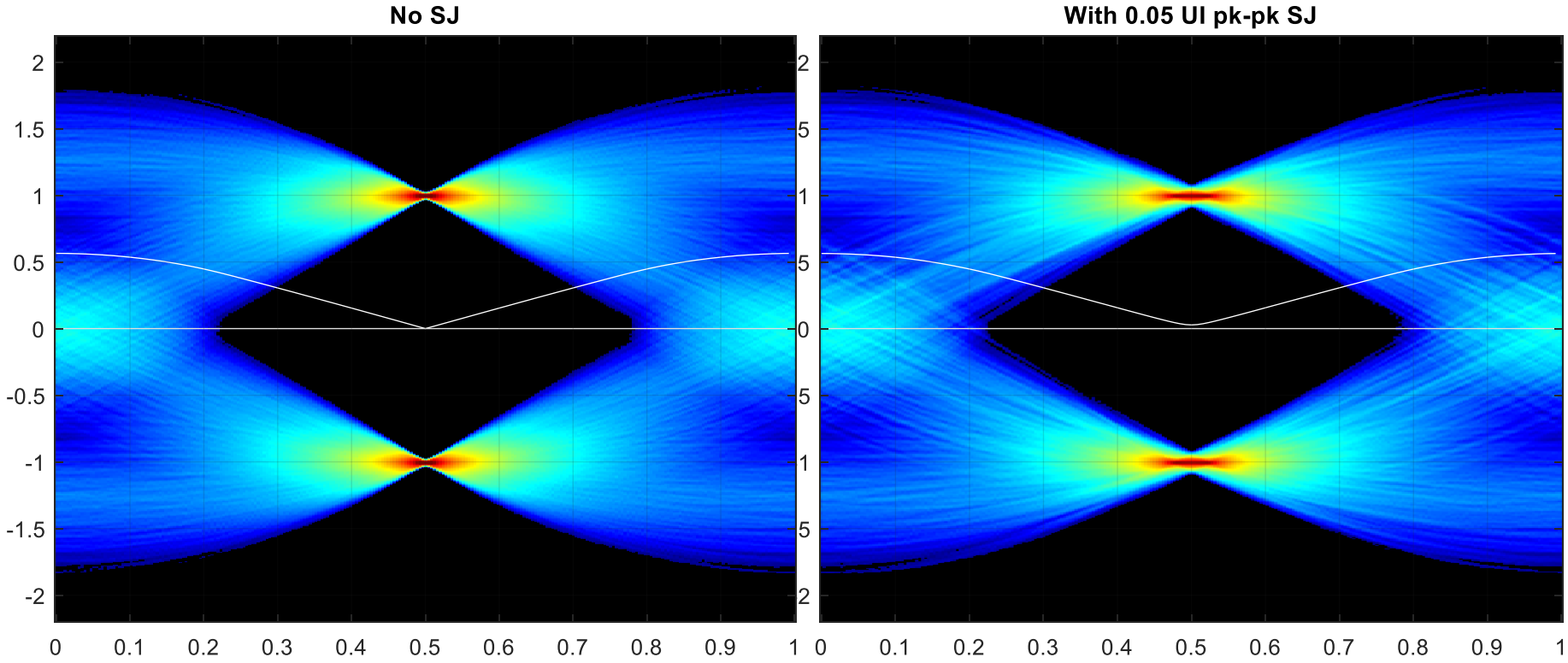
Choosing a better corner frequency

- Changing the block size for symbol phase correction changes the effective jitter corner in inverse proportion
- The 802.3 family of 100 Gb/s PAM4 optical transmitters are specified with a clock recovery unit (CRU) with a corner frequency of 4 MHz (Jpkpk*fJitter=3.76e-6 s.Hz) and a slope of 20 dB/decade. The corner should be set lower than 4 MHz for this DSP-heavy PHY
- The same Jpkpk*fJitter for the 100GBASE-ZR signalling rate of 27.9525 gives 2.1 MHz
- If we choose 2.17 MHz, a block size for symbol phase correction of 7000 UI can be used to give the effect of the CRU (matching the roll-off: 6000 to match the -3 dB points) 7000 is an integral multiple of the 1000 UI block size used for optical phase correction
- If we choose 1 MHz, a block size of 13,000 UI (roll-off basis) to 15,000 UI (-3 dB basis) can be used

For balance, we should make the related change to the receiver spec

- Should include the usual sinusoidal jitter to a normative receiver spec
  - e.g. the equivalent of stressed receiver sensitivity (here, 154.9.15 Receiver OSNR)
  - with the same jitter corner frequency
  - In the proposed remedy, this is rounded to 2.2 MHz
  - 0.05 UI of SJ is small as compared with the noise that takes the BER to the spec 4.62e-3, so not proposing changing the OSNR numbers for this
  - Next slide shows that the effect on EVM is small enough when the SJ frequency is well above the corner

Effect of 0.05 UI SJ on EVM is very small



- Perfect eye with 20% excess bandwidth
- Standard deviation of signal (white line) is 0.0275 at sampling phase
- Very small effect on EVM, but it is included

Conclusion

1. Include the effect of a CRU in the definition EVM for 100GBASE-ZR
   - 2.2 MHz seems a suitable choice
   - This may be implemented by a block size of 7000 UI for symbol phase correction only

2. Consider including the usual SJ in 154.9.15 Receiver OSNR, with the same jitter corner frequency